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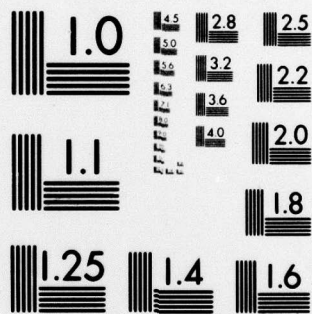
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MEMORANDUM

Serial No. 759-MR
February 5, 1963.

TO: Scientific Staff
FROM: M. A. Ransone
SUBJECT: Standard Calibration of Velocimeters.

↘ This note is to outline the procedure involved in producing stabilized baths for the velocimeter standard calibration, as set forth on page five in N. W. Lord's memorandum of 17 January, 1963, serial no. 749-NWL.

↘ The basic problem is to bathe the transducers of the velocimeter in an isothermal body of distilled water at various temperatures. This may be done by a series of heat exchanges which will tend to damp out temperature fluctuations.

A single hot plate will supply the heat needed to reach the various temperatures desired. Placed one inch below a copper bowl, it will heat the bowl evenly. This bowl has on its outside a copper tube helix which may be used as an alternate heat source by flowing fluid through the tube. Inside the copper bowl is a lucite bowl. This is prevented from contacting the copper by means of insulating standoffs. The 1/4" space between the bowls (both bottom and side distance) is filled with water. The lucite bowl is filled with pure distilled water and topped with a cover of lucite. Through this cover extends the bottom plate of the velocimeter. When the copper bowl is heated it will in turn heat the 1/4 inch of water, which will heat the lucite bowl. This bowl will heat the pure distilled water that is to be temperature stabilized. This will be a slow process, as the lucite is a poor conductor of heat.

The electric current of the heater is turned on for a short period of time and

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then turned off. The temperature of the bath will rise slowly, reach a maximum, and level off. It is at this time that the heat being added to the bath is equal to the heat being lost by the bath. This condition may last for several minutes, depending upon room conditions. Following this, the heat loss will be greater than the heat gain and the temperature will drop. The exact beginning and end of the stable temperature period cannot be observed on the thermometer, which is not sensitive enough. However, dramatic changes in the readout record of the velocimeter provide the observer precise knowledge of the bath's temperature stability.

II. - Description of items in system:

The items of the system are simple and are either inexpensive commercial items or especially made here.

They consist of:

1. A 660 watt open coil element hot plate of the one heat single burner type. Sears and Roebuck type 34A68091 or equivalent is best.
2. A spun copper bowl with a copper tube helix soldered to the outside made at Hudson Labs as per Mech. Drafting Drawing No. 421AA007.
3. A lucite bowl with insulating stand offs shown on the above drawing.
4. Three glass stirring rods, Central Scientific Co. - type 18837-4(D) 1/4" diameter rod-double propeller, or equivalent.
5. Three laboratory stirrers - Fisher "Fultork" and stands to hold them.
6. A special lucite tank cover made at Hudson Labs as per Mech. Drafting Drawing 421B002, modified as required.
7. Thermometers, 0° - 100° centigrade, graduated in 0.1°C.
8. Two 0° - 100° centigrade thermometers graduated in 0.1°C which are calibrated periodically at the National Bureau of Standards at intervals.
9. One variable timing switch.
10. Assorted nuts, bolts, tubing, etc. for assembly.
11. Stand to set copper bowl 1" above heater - heater is 4 inches high.

III. Procedure

1. Calibrate thermometer used with velocimeter with NBS thermometer. This thermometer is used so that undue stress is not put on NBS thermometer. This must be done every time with a NBS thermometer which is not used more than 12 times without recalibration.
2. Place copper bowl on stand one inch above the heater.
3. Connect the top end of the copper coil to a cold water tap and the other end to a drain.
4. Place the lucite bowl (cleaned and flushed with distilled water) with its spacers in the copper bowl, making sure that the centering is correct.
5. Fill the space between the two bowls with distilled water to within an eighth of an inch of the top.
6. Bolt the velocimeter (with the electronics section thermally insulated from the transducer plate and without the pressure case) to the special lucite tank cover. Nylon nuts and bolts should be used.
7. Insert the stirring rods through the tank cover and secure them by means of rubber bands.
8. Fill the lucite bowl with distilled water to within 1/2 inch of the top.
9. Set the velocimeter-tank cover on the lucite bowl, making sure that it is well seated.
10. Orient the cover so that the thermometer access tube points to the side (either).
11. Release stirring rods and insert them into stirrers making sure that they are well into the water and are free to turn.
12. Add distilled water, as necessary, to cover crystals of transducers. This may be done through one of the various access holes in the tank cover.
13. Insert the calibrated thermometer into the distilled water by means of the access tube provided. The bulb of the thermometer should be centered

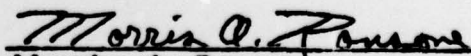
under the ray path of the acoustic pulse of the velocimeter. The use of a rubber grommet to hold the thermometer in place is recommended.

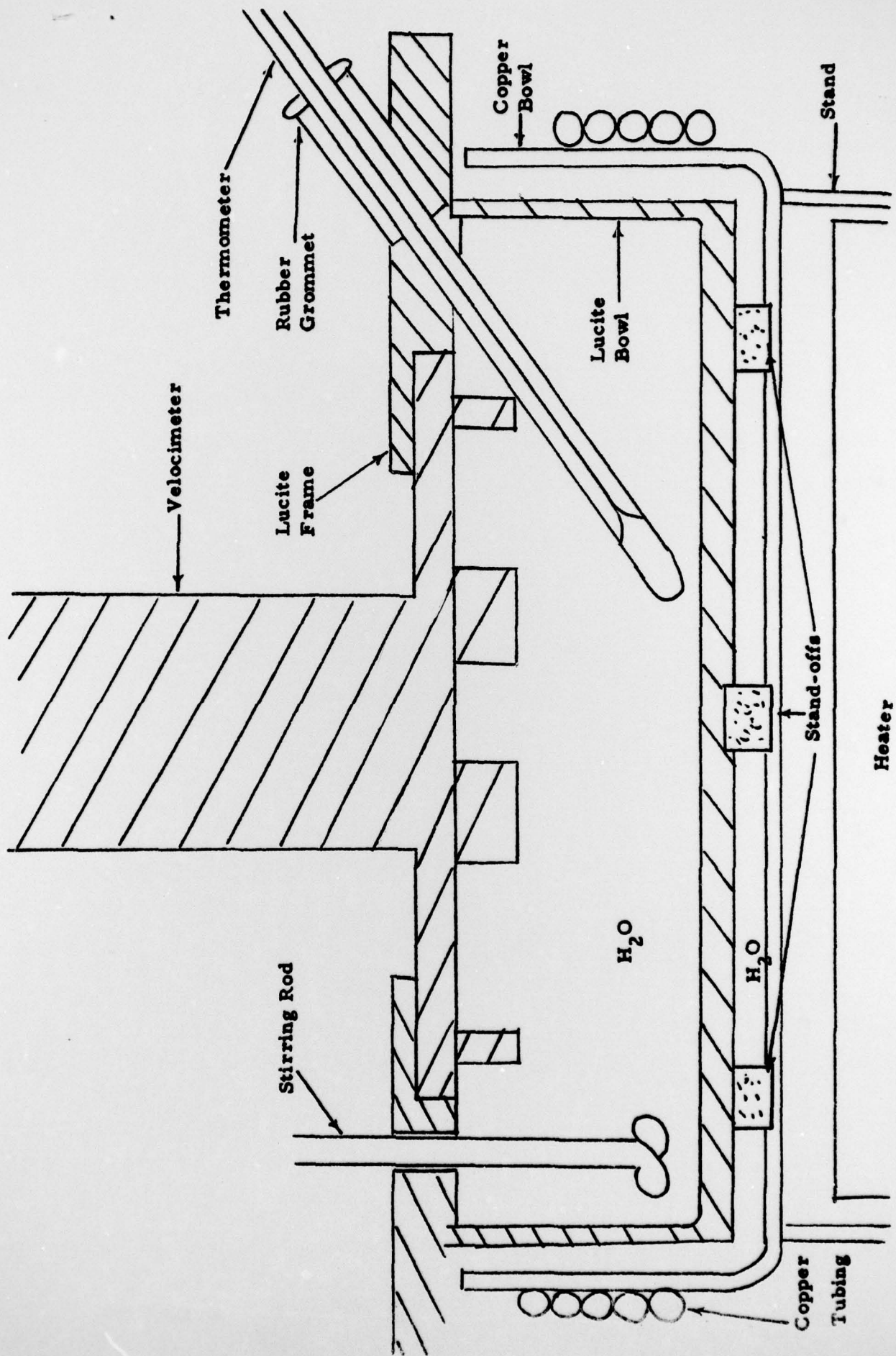
14. Plug the heater into the variable timing switch.
15. At this point the isothermal bath system is ready to be put to use.
16. Start the stirring motors.
17. Open the valve on the water tap so that a light, steady flow of water is going through the copper coil on the copper bowl. Leave for twelve hours or more (overnight). The bath at the end of this time should be isothermal at a point slightly lower than room temperature.
18. Take frequency measurements and temperature measurements. When sure of stability and frequency, proceed to step 19.
19. Shut off water tap valve.
20. Apply 2 minutes of heat to system by means heater using variable time switch. (May vary according to room set-up).
21. Wait for frequency and temperature at desirable point to remain constant - take reading.
22. Add heat (slightly more each time). Go back to 21.

IV. The two NBS calibrated thermometers are nominally reserved for use with velocimeters. However, they may be borrowed for other laboratory calibrations of thermometers on a controlled basis. A record must be carefully kept of the temperature cycle they have been subjected to. This must be taken into account with the velocimeter thermometer calibration. At the moment, a cycle of 20-50-20 °C over several hours is planned for each of these. After twelve such calibrations the standard thermometer will be returned to NBS for a new calibration.

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Morris A. Ransone
Research Assistant
Contract Nonr-266(84)



Serial No. 759-MR
February 5, 1963.

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